

FREIGHT CAR EFFICIENCY

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Of all the general problems of railway transportation there is none more important, more intricate of solution than that connected with freight service. The efficient performance of this service by the railways has become absolutely necessary to the economic progress of the community; no mean part of the social superstructure of the modern state rests upon it. Hence there emanates from the public a peremptory demand that this function of the railroad corporation shall be discharged with the maximum of efficiency. Inadequacy of organization or incapacity of management affects not only the revenues of the transportation companies, but the general weal of the state. It is claimed even, and not without effective argument, that the economic and social loss to the state through such inefficiency, absolute or relative, is infinitely greater than the loss to the transportation companies, severe though that may be. As to how far, in theory, this may be considered to justify the intervention of the state may well be left for discussion by the theorists with just the note that, even theoretically, the moral justification of such interference must rest entirely upon the presence of fairly conclusive evidence that the state, by its intervention, can improve the situation, with due regard to both present and ultimate results. In practice, however, the public is not apt to wait for moral justification, and unsatisfactory management leads to a discontent and agitation which frequently crystallize into restrictive legislation of a more or less severe type. Aside from the matter of earnings, it is then to the interest of railroad management to discharge the functions, for which it is responsible, as adequately as possible. Supreme in importance among these functions as the freight service is, public attention and demand have naturally been directed to the manner of its discharge to a greater degree than to any other aspect of railroad performance. The public demands for the members of its community (a) equality of treatment, and (b) a service characterized by adequacy, expedition and economy. The problem of the handling of the freight service is obviously, therefore, very complex; in fact, it is a series of problems rather than a single one. The limits of this paper forbid any exhaustive treatment of the whole subject, and I intend to restrict myself very largely to a consideration of the more general features of freight car efficiency, noticing the extent to which the railways have adjusted their equipment and its handling to the gigantic industrial development of recent years.

The general prosperity has been reflected, of course, in the growth of railroad business, which has been positively astonishing. The railroads of the United States probably handled, during the year ending June 30th, 1907, in the neighborhood of 1800 million tons of freight. The freight handled by the whole of the railroads of teeming Europe can hardly have much exceeded 1500 million tons. Physical conditions, and political prejudices and fears have co-operated in keeping at a low level the average haul in Europe, and, consequently, the more favorable environment here has placed the ton-mileage—the true measure of the freight service of a country—out of all comparison with that of the older continent. During the years named, the ton mileage of the United States probably amounted to 230 or 235 billions, against which, Europe, so far as can be estimated, could not present more than about 100 billions. It goes without saying that enormous difficulties have to be met and overcome in order to administer successfully so huge a mass of business, diffused over a territory of more than three million square miles. But the real extent of these difficulties is not realized until it is comprehended that, during less than a generation, specifically, since 1880, the ton mileage of this country has not merely doubled or trebled but actually septupled itself, an increase of more than 600 per cent. Under these circumstances, it would not be surprising to find the railroads experiencing difficulty in meeting the ever-increasing demands being made upon them, nor would it necessarily be discreditable to them that, in shaping their organization to the changing conditions, there resulted considerable friction of adjustment. Accordingly, the existence of shippers' complaints with reference to car supply, founded though they may be on facts, should not be regarded, in itself, as conclusive evidence of culpable negligence on the part of the managers of railroad transportation. Even without any special general development from year to year, every business has difficulties during the busiest season of each year, in properly meeting the demands made upon the resources of its organization. In arguing thus, there is no desire on the part of the writer of the paper to justify the railroads in carelessness of management, whenever such exists, but his object is to deprecate the measurement of railroad performance by an impracticable standard, which the critics themselves would not consent to apply to their own business undertakings.

In the just-issued nineteenth annual report of the Interstate Commerce Commission on the statistics of Railways in the United States, figures are given covering the results of railway operation during the year ending June 30th, 1906, and a comparison of them with the corresponding figures for 1900 may serve as a text with which to introduce what I have to say. The ton mileage of the railroads operating in 1900 was 141,596 millions; in 1906, 215,877 millions—an increase of 52½ per cent, of which 40 per cent occurred during the latter year. Though the mileage increased by no less than 31,017 miles during the six years, freight business was received and taken

care of so well that the density of freight traffic, measured in tons carried 1 mile per mile of line, increased from 735,352 to 982,401 or about 35 per cent. The mere fact that the railroads were able to take care of this remarkable increase is an indication of the entire inappropriateness and injustice of those general charges of inefficiency which superficial observers, including some writers for the press, have felt themselves free to make. So great an achievement has been possible of accomplishment only by reason of the fact that past freedom of development (subjected though it has been to certain restrictions) has stimulated the growth of the most enterprising railroad policy in the world, admirably suited, in many ways, to its economic environment; it is not denied that this freedom has permitted some evils to thrive, though less during the last few years than previously.

The freight car equipment during the period was enlarged from 1,365,531 cars to 1,837,914 or $34\frac{1}{2}$ per cent increase. At first glance, this compares unfavorably with the $52\frac{1}{2}$ per cent increase of business. That this is not really so is obvious when the capacity of the car is taken into account. So far as I can judge from the equipment statistics, the increase of average capacity from 1900 to 1906 must have been close upon 20 per cent. Assuming that this increase of capacity were made full use of, the increase of car accommodation would be $61\frac{1}{2}$ per cent. The enlargement of the freight car was not accompanied, however, by a raising of minimum weights, so that, in some cases, shippers made no practical use of the extra space facility. Hence, we cannot regard the whole of the $61\frac{1}{2}$ per cent as an actual increase of facility to the shipping public: it requires modification in proportion as the average car loads shipped by the various industrial and commercial concerns were not easily susceptible of increase. It must be borne in mind that, primarily, the transition to higher capacity cars is in the interests of the railway operator. Subject to a certain amount of qualification, it may be said that, under normal conditions, the shipper prefers smaller cars and more of them to larger cars and fewer of them. But, in either case, the practical meaning of the car to him is measured by the position of carload minimum, marking as it does a very considerable difference in transportation charges. Of course, in the long run, under a competitive régime, the shipper is deeply interested in the high capacity car proposition because its utilization, in preference to smaller cars, means greater economy of operation, part of the benefit of which is likely to go, sooner or later, to the shipper.

The idea suggests itself here that, while working towards the higher capacity car, the railroads would be unwise to attempt to impose it upon the shipping public unless the conditions of freight movement were favorable, otherwise considerable inconvenience might result to those whose business organization and relations could not readily be adapted to larger units of distribution. Thus, if increase of car capacity were the sole consideration, an increase of car

equipment (but not of car numbers) corresponding with the growth of tonnage to be transported, though theoretically a desirable achievement, might be no small impediment to the manufacturer and dealer in their efforts to attain maximum business expansion. It is to the credit of the far-sightedness of the leaders of railway policy that, while fostering, for several years, the growth of the larger and more economically operated car, they refrained from even the appearance of coercion in connection with their economical utilization. Thus from the beginning of the present century, the increase of car size steadily proceeded, generally speaking without any notable sacrifice of number, but the carload minimum remained stationary.

The last general movement in the direction of increase of minimum carload weights was, I believe, in 1899, when under the Official classification, general weights were raised in all the classes from 20,000 to 30,000 pounds, after having stood at 20,000 pounds for third class and higher, and 30,000 pounds for fourth class and lower, during a number of years. At the same time, the Western classification minimum for lower than third class was raised from 24,000 to 30,000 pounds, four years previously the minimum for lower than third class had been increased from 20,000. The Southern classification minimum of 24,000 pounds for all classes has remained undisturbed, for all practical purposes, during the last twenty years. Recently, however, a movement has set in towards an advance of existing minimum weights, to accord with the very pronounced advance of the last few years in average car capacity, and this has already found partial, though not very startling, realization in the Official classification.

The policy of the railroads, it is plain, has been marked, in this regard, by great conservatism, and they have amply showed their desire to allow reasonable time for the assimilation of shipping methods to the improved car facilities. They are hardly open to charges of arbitrariness or inconsiderateness in now attempting to take an active step towards the realization of aims long announced, looking to the more effective use of the car accommodation they have provided. If there be any room for criticism at all, it should be directed towards the actual increase of minimum weights in individual cases with regard to the effect of the same upon existing methods of distribution in the industries concerned. But no general opposition to the increase of minimum weights simply because it is an increase is logically well grounded, under the conditions.

The possible effect of the actual organization of the distribution of products in hindering full use being made of increased car capacity, secured through the substitution of a smaller increment of higher capacity cars for a larger increment of smaller capacity cars, has now been considered. It may be further observed that changes in the general character of production, while not preventing full use of car space provided, may similarly hinder an increase in car capacity, equalling in percentage the increase of business to be handled

in ton miles, from establishing an equality of adjustment of freight equipment to traffic. The character of the tonnage may have altered so that equality of car adjustment can be secured only by a relative increase of car capacity. For instance, to take a hypothetical case of as simple a character as possible, if the tonnage at the beginning of the period of comparison were three-fourths coal and pig iron and one-fourth merchandise and hay, whereas, at the end of the period, the proportions were half and half, each cubical foot of car space would be less efficient on account of the greater space demand of each average ton of freight carried. To some extent, a movement of this kind has been in operation, but, by reason of the continued marked preponderance of heavy freight in railway tonnage, probably not sufficiently to reduce very materially the effectiveness of increase of car accommodation calculated on nominal capacity, yet it is worth bearing in mind that the real working capacity of a car is not its stenciled maximum, or, rather, that plus the additional ten per cent allowed, but the average tonnage it can accommodate of the class or classes of freight it is commonly required to convey.

So far as the practical results of American freight operation of recent years are concerned, it is not at all difficult to demonstrate that, coinciding with the movement towards a high tonnage car, there has been a material increase in average load, indicating that, to a certain extent at least, such a car has proved adaptable to modern methods of industrial distribution. To quote a few roads indiscriminately, the average carload per loaded car during the period 1900 to 1907, increased with the New York, New Haven and Hartford from 10.2 to 13.4 tons, with the Norfolk & Western from 19.9 to 25.5, with the Wabash from 14.9 to 18.1, with the Louisville & Nashville from 15.3 to 18.7, with the Illinois Central from 13.7 to 17.8, with the Southern from 12.7 to 14.8, with the Chicago & North Western from 13.8 to 15.3, with the St. Louis & San Francisco from 13.6 to 15.9, with the A. T. & S. F. from 12.7 to 15.5, with the Northern Pacific from 13.4 to 17.8, and with the Great Northern from 16 to 20.4 tons. According to the 1906 statistical report of the Interstate Commerce Commission, the loaded freight car miles for that year amounted to 11,410,599,327, and, as before stated, the ton-mileage to 215,877,551,241. From these figures, it appears that the average load per loaded car of all systems was 18.9 tons. It is impossible to say exactly what the average load was for 1900, on account of the failure of the Commission to collect and publish loaded car mileage before 1901, and, by the way, their Public Service tables still neglect the average load per loaded car. However, the average load for 1901 was 16.5 tons, and, after an examination of the reports of a considerable number of railroads, I am inclined to think that for 1900, the corresponding figure must have been, approximately, 16 1-5 tons. Thus the increase of average load per loaded car was about 17 per cent. The proportion of this increase due to higher capacity equipment and to improved loading methods respectively are not capable

of being determined. After having observed loading methods fairly closely during the period, it does not strike the writer that there has occurred any particularly marked advance in this direction. The exceptions to this general statement are but sufficient to "prove the rule." Accordingly, I prefer to credit the higher capacity equipment with the greater part of the improvement. From 1900 to 1906, then, a twenty per cent increase in average capacity has been met by a seventeen per cent increase, or thereabouts, in average load, indicating, as already remarked, the suitability of the high capacity car, within certain limits, to present industrial conditions. From this it follows that the deduction to be made from the $61\frac{1}{2}$ per cent increase of total car capacity during the period of our comparison, on account of shippers being unable to use to advantage the extra space of each car, is but small, and, assuredly, not sufficient to reduce the per cent increase of effective accommodation below the $52\frac{1}{2}$ per cent increase of business.

In the matter of adequacy of car accommodation, therefore, I fail to see how there can be any reasonable dissent from the conclusion that, under the unprecedented boom of business, the railroads, as a whole, have done astonishingly well in keeping their equipment level, and probably more than level, with the rapid increase of agricultural, mining and manufacturing output.

I say this of the railroads as a whole; thus qualifying my statement because there are individual roads of which it could not be made, just as there are other roads of which more than this could be said. Quite a few railroads have not only managed to keep level with present needs, but have even anticipated future requirements, evidently determined, whatever the cost may be, to provide an adequate amount of car accommodation for their patrons. On the other hand, there would appear to be roads who are not indisposed to piece out their own inadequate car resources with forced loans from their more plentifully supplied neighbors, a larceny which the current of traffic hinders these good neighbors from effectively stopping. The saying attributed to a certain wit: "God help you if you get into the hands of your friends" is entirely apropos of the freight car situation in some respects. Curiously enough, some of the roads who, according to the bulletins of the committee of car efficiency, have been maintaining on their lines a marked excess of cars (amounting, in one case, to fifty per cent, and, at times, to a hundred per cent over the number owned),¹ have really not done badly in the increase of their cars during recent years as compared with the increase of their business. For instance, in the case to which I have made reference, the company increased its freight cars, during the seven years ending in 1907, fifty-one per cent, as against an increase of ton mileage of forty-four per cent, the difference being still greater

¹The statement refers, of course, to the period prior to the present abnormal depression.

in favor of the equipment when capacity is taken into account. Its record of ton miles per freight car in 1907 does not appear excessive on the face of it, when compared with that of numerous other companies. Of course, the explanation of its persistent retention of foreign cars lies in the nature of its tonnage which is comparatively light and bulky, thus necessitating a larger proportional number of cars than is necessary for roads with heavier freight; its own equipment was evidently inadequate in space accommodation in 1900 (possibly lethargic car movement played some part) and the improvement accomplished subsequent to that date was obviously insufficient to reduce to really moderate proportions its demands upon foreign equipment. The light and bulky nature of the freight carried, occupying much car space per ton, explains also the moderate car ton-mileage record.² The unfortunate feature of a policy of foreign car detention is that it necessarily deprives other roads of equipment, usually at the time when it is particularly needed, so that the whole car situation of the country is disturbed. The railroads of the Middle West with their extensive forwarding business are conspicuous sufferers, and the roads in New England, on the Pacific Slope and in the Southwest conspicuous gainers by the inter-line shuffling of cars. In the old days, when freight was transferred at every junction point, it was necessary for each participating carrier to own sufficient cars to haul the freight over its own lines. It would seem proper that the introduction of inter-line organization should not change this requirement. Of course, the proportion of home and of foreign cars on the lines of a railroad will be determined, to a great extent, by the direction of the stream of traffic. Lack of promptness in handling foreign cars will soon swell up the number of such upon a road with the stream of traffic traveling towards it. Given a fairly dense and growing local traffic, substantial moral fibre is required to resist the obvious temptation—sometimes the moral element fails to make good. On the other hand, roads doing a large outward business but comparatively small inward must make allowance for this extra drain in the extent of their equipment. They must expect to be regularly deprived of the use of a certain proportion of equipment, and it is up to them to do the best that they can to keep track of its movements and to secure the enforcement of mutually agreed upon regulations directed towards securing prompt return.

One of the difficulties connected with *per diem* as a means of stimulating the prompt handling of foreign equipment is that at the times

²Heavy freight would have revealed a striking ton-mileage per car. The car ton-mileage, at any one time, is the quotient of the *total* ton-mileage divided by the number of revenue cars *owned*. In general, this represents sufficiently accurately the performance of the average car on the normal railroad, but not in the case of roads with large standing excesses of cars (or the reverse); the real work secured by such railroads out of the cars operated by them can only be obtained by substituting, as the divisor, average number of cars *on line* for average number of cars *owned*. Allowance needs to be made, of course, for private cars.

when cars are in most demand it is least effective. Whether the cost of car hire be 20, 25 or 50 cents a day, or even a dollar, it is obviously to the interest of a road short of cars to retain foreign equipment if, during the rush of business, the cars are capable of earning more than sufficient to cover operating and *per diem* expenses.³ Conversely, when business is dull and cars less urgently needed by the home roads, low car earnings stimulate the effectiveness of *per diem* to the cost of, it may be, unnecessary empty mileage. There seems much to be urged in favor of a variable *per diem* charge, especially if handled, along with the whole matter of car interchange arrangements, by some permanently organized central bureau of the railroads. This is a tempting subject to dilate upon, but one impossible to discuss adequately in this paper.

Reference to the problem of car interchange brings our discussion very close to the matter of car shortages, the recent acute attack of which was so dramatically terminated at the close of last November by the financial crisis, whose industrial effects are still lingering with us. The more one studies the car situation in general, the more one realizes that the intensity of such car famines, as they recur from time to time, could be materially relieved if more skillful attention were applied to the supervision and improvement of the distribution and of the mileage performance of cars both in local and in interline business, the crowning difficulties of railroad

³Suppose that, during the very active season of the business year, a car is capable of earning \$2.50 a day after the costs of hauling the car and handling the freight (but not the maintenance charges against the car) are deducted. The railroad has more business than it can handle promptly with its own equipment, and, therefore, must either build extra cars just for the traffic of this road or it must borrow. If the period extends over, say, three months, then, if it builds, it ought to debit all expenses of the cars to that short period. These expenses, in the case of a modern car, a forty ton steel under-frame box car, for instance, probably average somewhere about 40 cents a day, the expenses of maintenance and renewals being distributed over the year, the car being assumed to be in more or less constant use. The estimate is based on \$1,025 as the cost of such a car, with 20-25 years as average life, 5 per cent interest on cost of car, \$85 or thereabouts as cost of repairs and renewals, allowance also being made for maintenance of repair tracks and sheds and rip tracks, tools and the like, including interest on the capital invested in them. But in the case before us, these expenses have to be distributed over but three months, allowance being made for lighter repairs, longer life of car, etc., on account of its more limited use. It is not possible to do more than estimate very roughly the appropriate charge against each day of the earning period but it probably would not be less than \$1.25 a day. Thus to earn the assumed \$2.50 a day, the railroad must spend (and could well afford to spend) \$1.25 a day during the period of the employment of the car if it should provide its own car. But if it borrows other companies' equipment for the period, it will incur hardly any maintenance charges, probably not amounting to as much as 25 cents a day, at the most. So that, under the assumed conditions, there is no inducement for the road to provide its own extra equipment, even if a dollar *per diem* were levied upon it, and, with a 50 cent or 75 cent *per diem*, it is considerably in pocket by borrowing equipment which it can send home as soon as it has no further use for it.

operation. In speaking thus, it is not intended to have inferred that, under any reasonably economical system of car equipment, the railways could obviate such shortages. As a matter of fact, the charges of gross inadequacy of equipment, so freely made by choleric shippers during periods of car shortages, are based entirely upon the reasoning that there is a shortage, that the railroads have no business to allow a shortage to take place, and that its existence is sufficient evidence of willful neglect on the part of the railroads to provide a proper amount of equipment. No consideration is given to the relation of that equipment to business requirements during the periods when surpluses take the place of shortages nor to the possible loss which may result to a railroad maintaining an extra supply of cars whose service is necessary, perhaps, only three months out of the twelve. Unless the daily earnings of such cars during the limited period of their necessary service are sufficient to cover not only the costs of handling the freight, of moving the cars, of use of roadbed, terminals, motive power and so forth, but also interest on capital invested in the cars, maintenance charges, depreciation and insurance, and storage accruing during the whole year, it is patent that the provision of such cars would be a pure act of charity on the part of the railroads, and in no sense a commercial transaction. I am not going to assume gratuitously that it would be necessarily unprofitable for any specified railroad to provide this extra equipment, but note the possibility as something that needs to be investigated before charges of incompetent management are rested simply on shortages in car supply during busy seasons. And in connection with estimation of car shortage, it should be noticed that the extent of the same is not accurately measured by shippers' demands, since they frequently order more cars than they really need in the hope of securing a larger number than they would otherwise be likely to do. The actual shortage at any date is, undoubtedly, less by a considerable percentage than the total of the shippers' nominal requirements.

Moreover, while this shortage is a very real difficulty at the times of its recurrence, it is, in large measure, the result of a tendency on the part of shippers to keep their stocks down to the working minimum, frequently involving procrastination in the ordering of their supplies. An annual example of this is to be found in the coal trade in which the dealers regularly fail to make long enough preparation ahead for the fall trade, so that, with the advent of the cold season, orders for cars are rushed in with instructions that they are to be treated as urgent. They (and many others) are anxious to combine all the advantages of keeping as little capital as possible tied up in their stocks with an absence of all the disadvantages that naturally attach to the undue crowding of business. A little earlier preparation, even if at the expense of tying up more capital in the shape of stocks and storage facilities, would, in many cases, be entirely reasonable, and a legitimate expense of the business. At any rate, if this natural organization of their business arrangements is not attended

to, such traders hardly ought to feel aggrieved if their aggregated demands make it impossible for the carriers to reply as promptly as they desire.

From what has been said, it must not be supposed that the railroads, on their side, are keeping down equipment to the level of the traffic of the least active seasons. As a matter of fact, they are providing cars in marked excess of this, and an appreciable portion of their equipment is lying idle or running light during the "off" season. The actual extent of their equipment is a compromise between the requirements of the periods of maximum and minimum trade. The railroads, of course, will continue to increase equipment so long as there is a reasonable profit arising from the receipts of the car during its active period after deducting the charges against it during both active and inactive periods. It is not easy to see how more than this can be expected from the railroads,⁴ though it may happen, in consequence, that cars demanded during only three or four months of the year are not supplied. Shippers do not always realize that the surplusage of cars is quite as important a matter to the railroads as shortage is to them. The railroads are most keenly interested, naturally, in balancing supply with average demand, though even then they are liable to be hit pretty hard by business depressions, as witness the 300,000 car surplus during the past two months, the expense of whose enforced idleness (if cost of repairs, renewals, insurance, interest and storage be considered as distributed equally throughout the year) can hardly have been less than four and a half million dollars.

There are then, difficulties on both sides. But I have already indicated that shortage evils are accentuated among the roads themselves by the action of certain companies in persistently retaining and improperly using the equipment of other lines, thus reducing the pressure upon themselves, but, at the same time, causing it to be more widespread. *Per diem* arrangements so far tried, though an improvement upon the old mileage system, have failed to bring about an equitable distribution. A resort to car pooling methods really appears to be the only alternative, if economy of equipment is to be a consideration at all. Granted that capable administrators can be found to take charge of such pools—and no one familiar with the official personnel of the railroads would deny this—their influence upon the car situation in general would be very real. Possibly, there could be established district pools with jurisdictions covering, say, Official classification territory, Southern classification territory, the Southwest, the St. Paul, Chicago, St. Louis, Kansas City and Denver territory, and the territory between the latter and the Pacific Coast, each of these district pools focussing in a central distributing office, which would receive full reports from the dis-

⁴In the matter of car equipment, that is, as apart from the question of car movement.

strict pools and would arrange for transfer of equipment from district to district when necessary. In each district, the pooling principle could be made to apply separately to each of the major varieties of cars, and, possibly, though the practicability of this is not quite clear, with a rough reference to their capacities. I have sufficient faith in the genius of the American railwayman to believe that the details of some such plan could be worked out satisfactorily. It is not unnatural that reluctance to enter into a car pool arrangement should arise from the dislike of some roads to hand over the management of part of their equipment to an external authority, and from a fear that they will thereby get the worst of the transaction. Indeed, it is very likely that, during the formative period and early operation of such a scheme, equitable distribution would fail, at times, to be attained, but, in the long run, it would surely work out to the general advantage of all the roads concerned, except in the case of those who now habitually rely upon other people's supply to make good their own deficiencies, and these we are not called upon to take into consideration.

Before concluding this paper, I should like to supplement the figures, with which the discussion of adequacy of car equipment was introduced, with one or two more relating to the cognate and equally important question as to how far such equipment is used efficiently. We have seen that the typical car of 1906-7 is considerably larger in capacity than the typical car of 1900; it is also performing a somewhat greater actual service. The real efficiency of a freight car is the resultant of two forces, if I may borrow the language of Mechanics, one the average load, the other the mileage it covers, that is, its average rate of movement. Put into figures, the measure of this product in 1906 was 117,450 ton miles as against 103,700 ton miles. in 1900, an increase of 13,750 ton miles per car, equivalent to $13\frac{1}{4}$ per cent.⁵ The average load for 1900 has been estimated at 16 1-5 tons, and from this it follows that the loaded miles per car averaged 6,285: in 1906, the corresponding figure was 6,208. This indicates a backward movement so far as the matter of car movement is concerned. But there are reasons why this result should not be accepted at its face value. By reason of the absence of proper statistical data covering the whole of the railway systems of the country during the years of comparison, I have been obliged to base the loaded mileage performance of each car upon the number of revenue cars owned at the end of the fiscal years. Obviously, the car mileage is made by the average number of cars owned throughout the year. If it were to be assumed that the net increase of cars, during 1900 and 1906 respectively, took place uniformly during these years, then the figures given above would be changed to 6,450 and 6,396, the decrease of miles per car being thereby reduced from 77 to 54. In dealing with the comparison of individual railroads, it would be necessary to take into account the fact that, at different periods and with different roads, the proportion of cars used in making the mile-

age to cars owned may vary, but, in dealing with all systems collectively, this is obviously unnecessary.

A further reason for neglecting the apparent decrease in car mileage lies in the omission of privately owned cars from the calculation, though the results of their movement are included in the record of total loaded car miles. If the proportion of private cars were the same in 1906 as in 1900, the net decrease as shown above would be slightly reduced, though the percentage of decrease would not be altered, of course. Private car statistics are not available but I should take it as unlikely that such cars attained quite as large an increase (relative) as railway owned cars, and, if this be true, a more appreciable reduction in both the absolute and the percentage decrease took place. For instance, private cars in 1900-1 were estimated to equal from seven to eight per cent of railway freight car equipment. If, during the following six years, they increased but twenty per cent in number as against the thirty-five per cent of railway owned cars, the net decrease of loaded car miles per car would be reduced from 54 to 19.

A still additional reason for modifying the result first arrived at is to be found in the varying nature of railway tonnage over the period. Coal and other mine traffic tends to limit the mileage performance of the cars engaged in it and, when such traffic increases more rapidly in volume than the rest, the effect upon general car mileage average is depressive. Undoubtedly, this has taken place, to a certain extent. The products of mines in 1906 accounted for more than 53 per cent of total originating tonnage, whereas, in 1900, the proportion was slightly over 52½ per cent. Mineral ton mileage and car mileage figures are not accessible but, no doubt, this movement is reflected in them, and though the difference in percentage is hardly large enough to exert much influence upon the average per car, it would probably be sufficient to wipe out the decrease with which the present analysis of car mileage averages started.

It is satisfactory to find that, the railway freight service being taken as a whole, there has been no absolute retrogression in the movement efficiency of the freight car, and yet unsatisfactory not to be able to say more than this. The efficiency of the freight car of 1906 over the car of 1900 is due entirely to improved load: there has apparently been no appreciable improvement in the average number of miles travelled per annum. Except in so far as the trader was able to secure lower rates, a supposition hardly justified by the facts, the benefits of the increased efficiency of the freight car during the period 1900-06 must be regarded as having been in favor of the railroad rather than the trader.

It is a somewhat remarkable fact that the power and ability displayed by railroad managers in so many directions has been unable to secure tangible improvement in a matter which is more vital than most things to the really economical and successful handling of a railroad. In scanning the results of freight operations during the

half dozen years covered by the main figures of this paper, one may observe with pride the handling of an increase of business of $52\frac{1}{2}$ per cent, with a train mileage increase of but 14 per cent ($492\frac{1}{2}$ millions to $559\frac{1}{2}$ million miles), and a consequent increase in train load of 42 per cent (271 to c. 385 tons), accompanied by an increase of 17 per cent or more (c. 16.2 to c. 18.9 tons) in car loading, but car mileage—the less said about it the better! Perhaps, it is incapable of improvement! But the query is inevitably provoked as to whether some of the improvements named have been purchased at too high a cost. The bulletins of the committee on car efficiency reveal great differences between the various roads in the mileage results obtained from their cars. Unquestionably, varying physical and economic conditions play an important part in these differences, yet one cannot help but believe that the personal equation, the organization of the railroad, is no trivial factor. To take but one illustration, the reports published impress one with the idea that a great deal of misapplied economy is frequently exercised with regard to shop repairs. No doubt, a road hauling heavy tonnage over adverse grades and around sharp curves must expect to be troubled more with the question of car repairs than a road working under the reverse conditions. Yet even in this case, the loss of car time may be seriously increased by lack of proper provision of shop facilities, usually a poor kind of economy, and, to the extent to which shop repairs accumulate, a lessening of the effective equipment of the road. In studying the returns covering July 1906, to August, 1907, one is surprised, again and again, by the high percentages of cars in shops, and high not merely during the period of slack business. Some roads apparently maintain, during the major part of the year, eight, nine, ten per cent of their freight equipment, or even more, as shop ornaments. More attention needs to be given to shop policy, and, one might add, to the treatment cars receive in the yards; with the needed improvement, one hindrance to better freight car performance will be removed.

Yard working affords even more fruitful opportunities of improvement. Terminal yard delays is a vexed problem that is apparently eternal in nature. Poor yard design, or, to be more correct in many cases, lack of design, has been condemned again and again as too common a feature, but it is by no means an unknown thing to find the evils of bad design supplemented by those of poor organization and still poorer management. I think a mistake has been made frequently in locating terminal yards too near the centers of the cities, though sometimes the growth of a city has been so rapid as to reach out to fairly distant sites, crippling the possibilities of their expansion by the immense resulting increase in land values. Again the storage privileges of terminal yards have been notably abused: to judge by the space which railroad managements are often prepared to assign to storage tracks in response to the "needs" of the shippers, they do not always realize that, in the physiology of the

yard system, the function of the storage yard is about that of the vermiform appendix. It is satisfactory to note, however, that demurrage regulations are being rounded into more uniform shape over the country at large and, with their steady enforcement, less trouble from shippers' delays can be expected.

Much more could be profitably said about the influence upon loaded car mileage of such trans-shipping arrangements as the Pennsylvania provide at Fort Wayne for the making up of "through" loaded cars at that point, thus reducing the pressure upon the Chicago yards, and much more upon the general extension of "consolidation" arrangements in relation to both increased average loading and mileage. A further interesting question is that of adequacy of motive power and the desirable ratio of such power to freight business and equipment: in this matter, as in so many others, there are marked differences in the practices of the various roads, the justification of which it would be desirable to have explained. These and many other sides of the question of freight equipment efficiency must regretfully be excluded from a paper already over-long, but I hope that some of the speakers will favor us with their opinions upon these subjects.

The lack of progress along the lines of car mileage is in such astonishing contrast with improvement in other branches of railroad operation, that everyone feels that something should be done to remedy the situation. There are many factors contributing towards a low daily car-mileage which are unavoidable, but advance along the lines suggested, and, perhaps, more radical measures, will certainly do something towards raising the present standard.

ADDENDUM.

The previous statistical analysis rests upon figures covering the operations of all systems, both large and small, during the years 1900 to 1906. It will be interesting to see how the general results are borne out and, indeed, emphasized, over a larger period, by the statistics of a group from which very small roads are excluded.

These are compared below, in the case of thirty-one railroad systems, some of the operating results of 1907 with the corresponding ones of 1897, a ten year period. The roads whose statistics were available are the following (arranged in alphabetical order):

A. G. S.	C. C. C. & St. L.	K. C. S.	N. P.
A. T. & S. F.	and P. & E.	L. & N.	Penna. R. R.
B. & O.	C., M. & St. P.	M. C.	Rock Is.
B. & M.	C. N. O. & T. P.	M. & O.	St. L. & S. F.
C. of G.	Erie.	Mo. Pacif. and St.	St. L. S. W.
C. & O.	G. N.	L. I. M. & S.	Southern.
C. & E. I.	G. T.	N. Y. C. & St. L.	T. & P.
C. & N. W.	I. C.	N. & W.	U. P.
			Wabash.

In 1907, these railroads were handling considerably more than half the railroad traffic of the country, and hence, in spite of some prominent omissions, are well representative of the more important systems. They owned 538,830 revenue freight cars in 1897 and 1,065,548 in 1907, an increase of 97.8 per cent. In calculating the average capacity of these cars, I have been compelled to omit, in 1897, the L. & N., N. P., Rock Is., Mo. Pacific, B. & O., St. L. & S. F., Southern, C. of G., and K. C. S., representing a total of 140,074 cars, on account of average capacity for that year not being ascertainable, but I have added to the list previously given the C. B. & Q. with 36,469 cars. For 1897, accordingly, the average capacity has been based upon 23 roads with 435,225 revenue freight cars, having a total capacity of 9,780,211 tons, thus giving an average capacity of $22\frac{1}{2}$ tons. For 1907, I have had to exclude four roads, the L. & N., C. of G., K. C. S. and Mo. Pacific, with 94,348 cars, but have again added the C. B. & Q. with 47,164 cars, making a net total of 1,018,364 cars, having a total capacity of 34,481,517 tons, or an average capacity of 33.9 tons. On account of the large number of cars included in the calculations, the omission of the roads named cannot materially affect these averages. An increase from 22.5 to 33.9 tons represents a percentage increase of 50.7, from which we can see much more clearly than in the case of the general statistics covering the shorter period, the really great advance made by the larger and more progressive roads in the direction of the increase of car capacity. When this 50.7 per cent increase of car capacity is combined with the 97.8 per cent increase of car numbers, an increase of 198 per cent of car accommodation is shown. How does this compare with the growth of business handled by these roads? The thirty-one systems handled, in 1897, 53,046,151,280 ton miles; in 1907, 136,037,276,970 ton miles, so that against the 198 per cent of car accommodation there has to be set only $156\frac{1}{2}$ per cent increase of ton mileage. The average load per loaded car mile was 13.4 tons in 1897, and 19 tons in 1907, an increase of 41.8 per cent.⁵ This substantiates the statement made in the body of the paper that there has been evidently a fairly economical utilization of the extra capacity of the enlarged car.

With respect to car movement figures, the 3,901,494,854 loaded car miles of 1897 represented 7,407 loaded car miles *per revenue car owned*. In 1907, the 7,143,781,875 loaded car miles average out to but 6,704 loaded miles per car owned, an apparent decrease of $9\frac{1}{2}$ per cent. With some of the most important roads included in the averages, the decrease reaches as high as $15\frac{1}{2}$ to 19 per cent. As noted already, these percentages would undoubtedly undergo reduc-

⁵The average is based on the 31 roads named in the list with the exception that the B. & M. could not be included in the average for 1897 on account of the absence of loaded car-mile figures for that year.

tion if adjustment were made for (1) average number of cars owned throughout each year, (2) railway cars owned but not on lines, or vice-versa, (3) average number of private cars operated throughout each year, and (4) proportion of coal and similar car delaying traffic to total traffic. It will be understood from previous remarks that the percentage results can be affected by adjustments under these four heads only when there is, in any of the cases, a percentage variation in the years compared. Should the proportions remain the same, the percentage of decrease could not be influenced by such adjustments. It is not unlikely that some roads would find it extremely difficult to account statistically for the whole of the decrease.



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